ZOOGEOGRAPHICAL CONDITIONS OF SNAILS LIVING ON GRASS-ASSOCIATIONS OF TWO HUNGARIAN LOWLAND REGIONS

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Abstract

The Danube—Tisza Midland and the lower Tisza region were compared as regards their loess, sand and saline as well as secondary grass associations. The results were evaluated on the basis of the zoogeographic system of BÁBA (1982).

According to the climatic conditions of the grass-associations their lowlands' character is indicated by the continental fauna circles (Ponto-Pannonian, East-West-Siberian, Caspian-Sarmatian). Due to the closure sward and moistening the ratio of certain fauna circles increases. The lower Tisza region — having more diversified soil conditions — is richer in snails prevealing the continenta fauna elements. The fauna circle differentiating the Danube—Tisza Midland is the Quercion frainetto

Introduction

As a consequence of the agriculture, melioration and draining work, beginning from the last century the natural grass associations — which formerly covered large areas of the Great Hungarian Plain — were strongly reduced or replaced by secondary plant populations. Malacological and zoogeographical investigations of these areas have become a pressing task.

Among the several plant associations of the Hungarian Plain the Loess heath-grass, as well as sedge and moor grass associations were heavily supressed by the agricultural cultivation and draining, at present they do exist only in fragments. The sandy wastes were eliminated, too. Spreading of secondary types of saline plantage shows an increasing tendence.

The aim of this study is to show the zoogeographical and malacological differences of the plant associations derived from the four grass associations mentioned above.

Materials and Methods

The samples were collected in Bugac, Csévharaszt, Kunbaracs, Ásotthalom (Danube—Tisza Midland) and at Alpár and Szeged (lower Tisza region) as well as in Nagytatársánc between 1966 and 1987. The $10 \times 25 \times 25$ cm square method was used in 30 places. For the zoogeographical analysis also the data of my earlier observations in Alpár and Szeged area (BÁBA 1969, 1976, 1985, 1987) as well as the

data of Hornung (1986) on the plant associations *Molinio-Salicetum rosmarinifoliae* of the soil trap in Bugac were used.

The zoogeographical analysis was on the basis of the BÁBA (1982) zoogeographic system, were continental and subatlantic fauna circle groups can be distinguished according to the climatic character of the fauna circles' spreading centers. The climatic type of the fauna circles could be characterized by linear regression functions at a significance level of P=0,1%.

The differences between the zoogeographical fauna circles of grass associations of the two examined regions were established by Chi^2 test.

Results and Discussion

1. Plant associations

The nomenclature of the examined plant associations was given according to Soó (1964) system Ordo and association, with the indication of their succession relations. Table 1 shows the distribution of snails collected from different plant associations.

Loess vegetation: Festucetalia valesiacae BR. BL. et TX. 1943; 1. *Salvio-Festucetum sulcatae tibiscense* ZÓLYOMI 1958 Lőszpusztarét (BÁBA 1976). It exists today in fragments only. On the influence of the antropogenous effect grass-lands often develop on the slopes of dams: Arrhenatheretalia PAWLOWSKI 1928; 2. *Pastinaco-Arrhenatheretum elatioris* (MÁTHÉ, KOVÁCS 1960) SOÓ 1971.

Sand vegetation: Festucetalia vaginatae SOÓ 1957.; 3. *Brometum tectorum* (KERN 1863) BOJKÓ, SOÓ 1934., one year brome-grass (BÁBA 1969, 1985, 1987) includes the *cynodontetosum* BORHIDI 1958 and *Juniperus communis* subassociation and facies. By its closure develops the 4. *Festucetum vaginatae darnubiale* SOÓ 1929 calciphilous sandy heath-grass. The list of species includes the normale KÁRPÁTI 1954. *fumanetosu* (MAGYAR 1933) SOÓ 1939, stipetosum capillatae (MAGYAR 1933) SOÓ 1959, *salicetosum rosmarinifoliae* (MAGYAR 1933) SOÓ 1959 investigations done in subassociations.

Festucetalia valesiacae BR. BL. et TX. 1943; 5. *Potentillo-Festucetum pseudovinae danubiale* BODROGKÖZY 1959 sandy grazing land. The *Astragalo-Festucetum sulcatae danubiale* (SOÓ 1939, ZÓLYOMI 1958), grazing was not investigated by us a secondary association which develops on sandy chernozem soil after, Alpár 1987., Bugac 1969., Molinetalia W. KOCH 1926; 6. *Molinio-Salicetum rosmarinifoliae* (SOÓ 1933) 1961 sandhill moor-grass. (Hornung 1986), Ásotthalom 1988. It constitutes a transitim to the moor-grasses *Molinetum coeruleae* (Allorge 1922) W. KOCH 1926, and to the *Festucetum vaginatae* (SOÓ 1964).

Saline grass associations: Puccinetalia SOÓ 1957; 7. *Agrostio-Caricetum distantis hungaricum* (RAPAICS 1927) BODROGKÖZY 1960. Saline sedge grass Alpár 1987. It turns into saline speargrass 8. *Agrostio-Alopecuretum pratensis* SOÓ 1933 ALPÁR 1987. Its extremely dry variant is *Camphorosmetum annuae* (RAPAICS 1916) SOÓ 1933.

As a consequence of the extreme conditions of blind saline plantage, no snails were found on it in the vicinity of Alpár and Szeged (Dorozsma, Fehértó, Sándorfalva). In the blind saline plantage on more humid and higher reliefs forms 9. *Lepidio-Puccinellietum limosae* (TOPA 1939) BODROGKÖZY 1958 saline plantage.

Weeds: At the base of dams Plantaginetalia majoris TX. 1950: *Lolio-Plantagi-*

Table 1. *Species and numbers of individuals in the plant-associations studied*

Species and Fauna circles	Number of species								
	Loess assotiations		Sand associations				Saline associations		
	1	2	3	4	5	6	7	8	9
1.1. *Pupilla muscorum* (L. 1758)	89	—	—	16	56	4	8	—	4
Perforatella rubiginosa (A. SCHMIDT 1853)	—	—	—	—	—	2	—	—	—
1.2. *Succinea oblonga* (DRAP. 1801)	—	1	—	—	—	5	—	41	21
Vertigo pygmaea (DRAP. 1801)	—	—	—	—	—	4	—	—	—
1.3. *Deroceras agreste* (L. 1758)	2	—	—	—	—	—	—	—	—
1.4. *Vallonia pulchella* (O. F. MÜLLER 1774)	44	3	—	5	—	3	2	—	—
Vallonia costata (O. F. MÜLLER 1774)	110	—	5	4	—	—	—	—	—
Vitrina pellucida (O. F. MÜLLER 1774)	—	—	—	3	—	—	—	—	—
Cochlicopa lubrica (O. F. MÜLLER 1774)	2	9	—	—	—	—	—	—	—
Zonitoides nitidus (O. F. MÜLLER 1774)	—	2	—	—	—	—	—	—	—
Euconulus falvius (O. F. MÜLLER 1774)	7	—	—	—	—	—	—	—	—
2.2. *Cochlicopa lubricella* (PORRO 1837)	—	—	—	—	—	3	—	—	—
3. *Enomphalia strigella* (DRAP. 1801)	1	—	—	—	—	—	—	—	—
Copaca vindobonensis (FER. 1821)	—	—	23	16	—	1	—	—	—
5.3. *Helicella obvia* (MENKE 1828)	—	—	—	1	748	—	26	—	—
Helicopsis striata (O. F. MÜLLER 1774)	—	—	26	74	46	2	21	—	—
Helix pomatia (L. 1758)	—	1	4	—	—	—	—	—	—
5.2.1. *Granaria frumentum* (DRAP. 1801)	—	—	—	19	16	—	—	—	—
8. *Truncatellina cylindrica* (FR. 1807)	3	—	14	19	—	13	—	—	—
Chondrula tridens (O. F. MÜLLER 1774)	17	—	—	30	3	50	—	—	—
Succinea elegans (RISSO 1826)	—	2	—	—	—	—	—	—	—
Monacha carthusiana (O. F. MÜLLER 1774)	5	2	—	—	—	25	4	8	—
Number of indivuals (1670)	280	20	72	187	869	112	61	49	25
Number of cases (24)	1	1	3	6	6	2	1	2	1

Plant-assotiations

1. *Salvio-Festucetum*
2. *Pastinaco-Arrhenatheretum*
3. *Brometum-tectorum*
4. *Festucetum-vaginatae*
5. *Potentillo-Festucetum*
6. *Molinio-Salicetum*
7. *Agrostio-Caricetum*
8. *Agrostio-Alopecuretum*
9. *Lepidio-Puccinellietum*

netum majoris (LINKOLA 1921) BERGER 1930 rye-grass plant association did not contain snails at Szeged, 1987.

As regards the snail occurrence 9 of the 11 examined plant associations proved to be suitable for zoogeographical studies.

2. Zoogeographical differences of snail associations

In the examined plant associations 1670 living snails of 22 species were identified. The plant associations significantly differ in their zoogeographical and cenological composition (Table 1, 2).

The loess association *Salvio-Festucetum* is characterized by the predominance of East-Siberian (1.1), Holarctic (1.4) fauna circles *(Pupilla muscorum, Vallonia pulchella, V. costata)*. Caspian-Sarmatian (1.3) and Holomediterranean *Chondrula tridens* (8) are coloruing elements. 2. *Pastinaco-Arrhenatherum* is characterized by the predominance of Holarctic elements (1.4) *(Cochlicopa lubrica);* the colouring elements change, an increase of the ratio of Ponto-Pannonian as well as Holomediterranean ones (8) is observed. In the common fauna circles a change of species occurs. Sand association: 3. In *Brometum tectorum* the fauna circles 5.3. Ponto-Pannonian *(Helicopsis striata)*, 3. Caspian-Sarmatian *(Cepaea vindobonensis)* are characteristic. The 8. Holo-Mediterranean *Truncatellina cylindrica* is a colouring element. In the 4. *Festucetum vaginatae* — which develops after sward closure — the number of Ponto-Pannonian and Holo-mediterranean fauna elements increases. A colouring element here is 1.1. East-Siberian *(Pupilla muscorum)*.

The dominant fauna circles in *Pontentillo-Festucetum* (5) are the East-Siberian *(Pupilla muscorum)* and the 5.3. Ponto-Pannian *(Helicella obvia)*. The 5.2. Quercion frainetto *(Granaria frumentum)* is a colouring factor.

Moor-grasses: 6. *Molinio-Salicetum.* The Holomediterranean *Chondrula tridens, Monacha carthusiana* are dominant fauna circles. The West-Siberian Vertigopygmaea and the Turcestanian *Cochlicopa lubricella* are colouring elements at the Danube—Tisza Midland, the latter being a differentiating fauna element in comparison with other plant associations.

Saline grass associations: the dominant fauna circle of *Agrostio-Caricetum* (7) is the Ponto-Pannonian one (condominants are *Helicella obvia, Helicopsis striata)*. The East-Siberian and Holomediterranean *(Monacha carthusiana)* fauna circles are colouring ones. In the humid 8. *Agrostio-Alopecuretum* the West-Siberian *(Succinea oblonga)* fauna circle is dominant, the Holomediterranean *Monacha carthusiana* is a colouring species.

As a consequence of the alcalization developed the *Lepidio-Puccinellietum* (9) where Siberian-Asiatic elements are dominant. The West-Siberian *(Succinea oblonga)* fauna circle is dominant coloured by the East-Siberian *Pupilla muscorum.*

3. Common and differentiating characteristics of grass associations

A decisive part of the fauna elements (90.49%) is continental independently from the site of the samples, collected from original or secondary plant associations. Sub-Atlantic elements represent 9.49%. The continental elements are derived from the following fauna circles: Siberian-Asiatic (1,1, 1.2., 1.3., 1.4.), Turcestanian (2.2),

Caspian-Sarmatian (3), Ponto-Pannonian (5.3). The Sub-Atlantic fauna elements belong to the Holomediterranean (8) and — with a few individuals — to the fauna circles Quercion frainetto (5.2.1).

From the possible 18 fauna circles (BÁBA 1982) only 9 occurred on the studied grass associations, what is due to the warm and dry climatic conditions. The examined grass associations developed historically in the climatic steppe epoch and preborealist: the loess and sand grasses, as well as saline grasses in the borealis. Their botanical character was given by the dominance of Pontian and other continental species (SIMON 1979).

Their survival was promoted by the climatic conditions of the Great Hungarian Plain (BORHIDI 1966).

JUHÁSZ (1974) showed that the high proportion of continental fauna elements can be supported also by the recent microclimatic conditions. As shown the air temperature at the soil surface presents a higher amplitude on saline grass meadow, top of dunes and on deeper regions than at 150 cm above the soil level. The humid loam soils use the received energy partly for transpiration, thus they are colder than drier sandy soils. Therefore the soil surface is of continental microclimate character.

Recent plant geographical studies (JAKUCS 1981) also confirmed the microclimatic, continental character of grass associations concluded from the presence of snail communities. From the point of view of plant geography loess meadows are described as of continental Eurasiatic character, sandy meadows as Continental-Pontean and Pontean-Mediterranean.

The single plantal succession circles in different grass associations are differentiated also by the presence or absence of certain fauna circles.

Loess meadows are characterized mostly by East-Siberian, Holoarctic fauna circles (Table 2) with a small Holomediterranean colouring effect. On sandy meadows Caspian-Sarmatian and Ponto-Pannonian fauna circles are dominant and also Quercion frainetto appears.

Table 2. *Percentile distribution of fauna-circles in different plant-associations*

Fauna circles	loess associations		sand associations				saline associations		
	1	2	3	4	5	6	7	8	9
1. Sibirian-Asian	90,7	75,0	6,94	14,97	6,44	16,07	16,38	83,67	100
1.1. East-Sibirian	31,78	5,0	—	8,55	6,44	5,35	13,11	—	16,0
1.2. West-Sibirian	—	—	—	—	—	8,03	—	83,67	84,0
1.3. Euro-Sibirian	0,71	—	—	—	—	—	—	—	—
1.4. Holarctic	58,21	70,0	6,94	6,41	—	2,67	3,27	—	—
2.2. Turkestanian	—	—	—	—	—	2,67	—	—	—
3. Caspian-Sarmatian	0,35	—	31,94	8,55	—	0,89	—	—	—
5.3. Ponto-Pannonian	—	5,0	41,66	40,10	91,36	1,78	77,04	—	—
5.21 Quercion frainetto	—	—	—	10,16	1,84	—	—	—	—
8. Holomediterranean	8,92	20,0	19,44	26,20	0,34	78,57	6,55	16,32	—
Continental	91,05	80,0	80,55	63,63	97,81	21.42	93,42	83,67	100
Subatlantic	8,92	20,0	19,44	36,36	2,18	78,57	6,55	16,32	—
	99,97	100,0	99,99	99,99	99,99	99,97	99,97	99,99	100
Number of species		7	5	10	5	11	5	2	2

A differentiating element of Holomediterranean fauna circle is *Truncatellina cylindrica* contrary to the loess and saline grass formations. Moor-grass meadows are characterized by the dominance of Holomediterranean fauna circles. Ponto-Pannonian and West-Siberian as well as increasing continental fauna circles dominate the saline grass formations.

4. Differences between the two investigated regions

Table 3 shows the zoogeographical differences of the grass associations investigated at the lower Tisza region and Danube—Tisza Midland. On the basis of the Chi^2 analysis fauna elements significantly differed in the two examined regions. This difference was supported also by the results of BÁBA (1983) who has investigated the forests of these regions.

ANDÓ (1969) emphasized the water permeability of subsoils as the most important microclimatic factor. In contrary to the water closing layer of the right bank of Tisza region, the water permeable layers of the left bank as well as those of the Danuba—Tisza Midland result in a drier, warmer microclimate. This is manifested by the differences in number of species and individuals of snails living in the lower Tisza regions' and Danube—Tisza Midlands' grass associations, as well as in those of fauna circles.

A further difference between the two regions is the higher species number in the lower Tisza region and the richness of Siberian-Asiatic fauna circles in species and individuals. At the Danube—Tisza Midland the presence of fauna circle Ponto-Mediterranean Quercion frainetto is of differentiating character, on drier sandy soils the deficiency of Euro-Siberian slugs as well as the relatively higher number of

Table 3. *Zoogeographical differences in the grass-associations of the lower-Tisza Region and of the Danube—Tisza Midland*

Fauna circles	Lower-Tisza Region number of species	of individuals	Danube—Tisza Midland number of species	of individuals
Sibirian-Asian	8	353	5	57
1.1 East-Sibirian	1	147	2	28
1.2 West-Sibirian	1	77	1	9
1.3 Euro-Sibirian	1	2	—	—
1.4 Holarctic	5	77	3	20
2.2 Turkestanian	—	—	1	3
3. Caspian-Sarmation	1	1	1	40
5.3 Ponto-Pannonian	3	151	3	797
5. Ponto-Mediterranean	—	—	1	35
5.21 Quercion frainetto	—	—	1	35
8. Holomediterranean	4	40	3	153
Σ Continental	12	505	11	897
Σ Subatlantic	4	40	4	188
Number of species	16	545	15	1085
Number of cases	10		13	

individuals of subatlantic fauna elements have the same function. Further investigations should promote the deficiency of Quercion frainetto and Turcestian fauna circle in grasses of the lower Tisza region and the absence of Eurosiberian fauna circle in the Danube—Tisza Midlands' grasses.

The separation of the two regions has started already in the Pleistocene due to the differences manifesting in the climatic character induced by the pedological and the water permeable soil layers. Similar differences were shown between the two regions by HORVÁTH, HORVÁTH and ANTALFY in 1954 and between 1962—1972, in boring samples from Felsőszentiván and from Szentes to Baja, during examination of the geological layers from Mindel to Würm III.

The layer structure of the two regions differ from each other in the mutual deficiency of 12 species starting from the Riss I. glaciale epoch. In the steppe epoch 6—17 species are to be found with East-, West-Siberian and Holoarctic fauna elements, which exist also today.

This early differentiation means that, due to pedological and climatic causes already in the Pleistocene developed those zoological differences which characterize the natural geographical small- and Midlands' regions existing now.

The landscape character of grass associations at the plain are formed by continental Ponto-Pannonian, Caspian-Sarmatian, East- and West-Siberian fauna elements. The continental character of grass associations is related since their formation to the semiaridous macroclimatic conditions of the Great Hungarian Plain, as well as to the microclimatic conditions assured by the presence or absence of water permeable soils and subsoil layers.

On the basis of the zoogeographical analysis of snail communities the relation between continental and subatlantic fauna circles corresponds to the results of plant geographical investigations.

Due to the moistening the West-Siberian elements in the saline grass associations become predominant. As a consequence of the alcalization the species number decreases during the plantal succession.

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Két alföldi tájegység gyeptársulásain élő csigák állatföldrajzi viszonyai

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Kivonat

A szerző a Duna—Tisza köz és a tiszai-Alföld két tájegységét hasonlította össze lösz, homoki, sziki és másodlagos gyeptársulásaik alapján. A feldolgozás Bába (1982) állatföldrajzi rendszere alapján történt.

A gyeptársulások klímajellegének megfelelően a pusztai jelleget kontinentális faunakörök indikálják (ponto-pannon, kelet-nyugat-szibériai, kaspi-szarmata). A gyepzáródással és nedvesedéssel más-más faunakörök részaránya nő. A két tájegység közül a változatosabb talajtani adottságú tiszai-Alföld gazdagabb csigákban, a kontinentális fauna elemek túlsúlyával. A Duna—Tisza köze differenciáló faunaköre a Quercion frainetto.

Зоогеографическое сравнение улиток, обитающих в травянистых сообществах двух областей альфёльдской степи

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Резюме

Автор сравнивает две области, расположенные в междуречьи Дуная и Тисы и в тисайской Альфёльдской степи, на основании лёссовых, песчаных, солончаковых и вторичных травянистых сообществ. В основу обработки результатов положена зоогеографическая система Баба (1982).

В соответствии с климатическими особенностями травянистых сообществ, их степной характер отражают фаунистические комплексы (понто-паннонийский, восточно-западносибирский, каспийско-сарматский). С закрытием и увлажнением дерна изменяется соотно-

шение преобладающих фаунистических комплексов. Из исследуемых областей тисайская Альфёлдская степь, обладающая большим разнообразием почвенных условий, богаче улитками, среди которых преобладают элементы континентальной фауны. Характерным фаунистическим комплексом междуречья Дуная и Тисы является Quercion frainetto.

Zoogeografski odnosi između dve nizinske oblasti na temelju pužne faune

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Abstrakt

Autor je usporedio dvije oblasti: područje između Dunava i Tise i Nizinu Tise na temelju lesne-, peščane-, slatine- i sekundarne ledične zajednice. Tema je bila obrađena sa BÁBA (1982) zoogeografijskom sistematikom.

Sa odgovarajućim klimatičnim osobinama ovih ledičnih zajednica indikatorna zajednica puža su kontinentalnog karaktera (ponto-panonskog, I—Z sibirični, kaspi-sarmatski).

Sa „zatvaranjem trave" i sa povećanjem vlažnoće menjaju se srazmere zajednice puža.

Sa prevagom kontinentalnog karaktera Nizina Tise ima bogatiji svet puža, to dolazi od mnogo raznovrsnijeg tla.

Diferncijalna zajednica područje Dunava i Tise je Quercion frainetto.